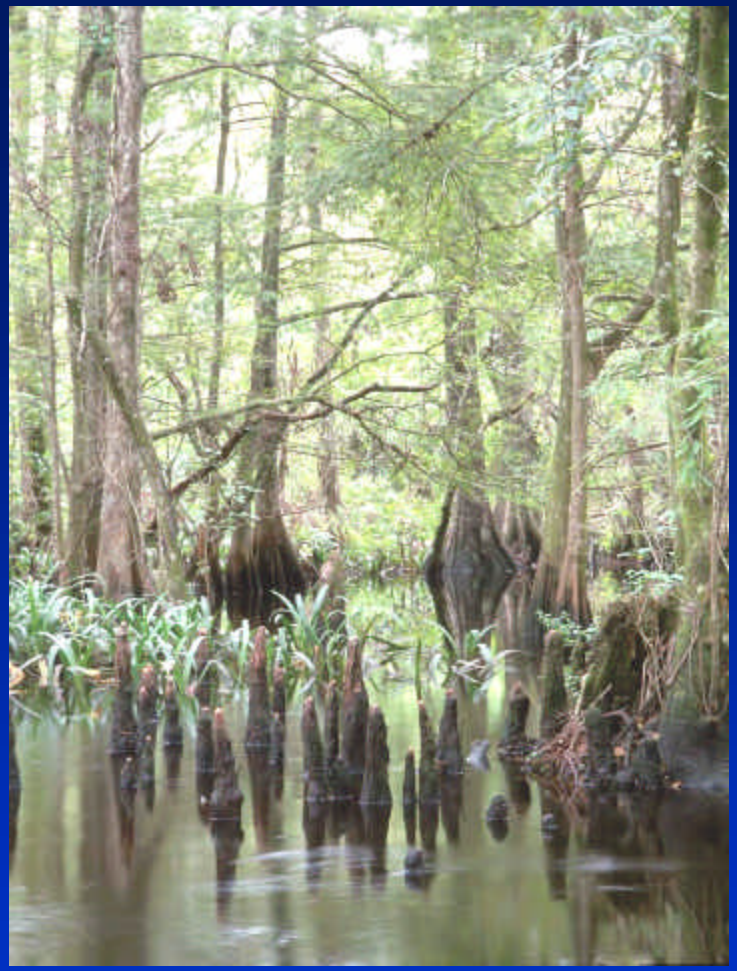
Minimum Flows and Levels for the Northwest Fork of the Loxahatchee River

By: Dave Swift
Lead Environmental Scientist
Water Supply Department
South Florida Water Management District
November 18, 2002



dswift@sfwmd

(561)682-6703

Loxahatchee River MFL Documents

Available on the Internet @ www.sfwmd.gov/ Major Projects/ Minimum Flows and Levels/ Loxahatchee River/ project documents

1. **Final Draft** *"Technical Documentation to Support Development of Minimum Flows and Levels for the Northwest Fork of the Loxahatchee River"*
2. **Draft MFL Rule for Northwest Fork of the Loxahatchee River (Rule 40E-8.221)**
3. **Appendices A-S (next week)**
4. **Staff responses to Peer Review and FDEP comments**

Overview

- Definitions
- History of Hydrologic Changes
- MFL Development Process & Methods
- Proposed MFL Criteria & District Commitments
- Rule Development Schedule

What is a Minimum Flow and Level?

- Florida law (Chapter 373.042(1) F.S. requires each water management district to establish Minimum Flows and Levels (MFLs) for surface waters and aquifers within their jurisdiction
- Also called instream flow protection criteria in other parts of the county, MFLs establish criteria that limit water use withdrawals from a surface water body or aquifer to protect the resource against significant harm

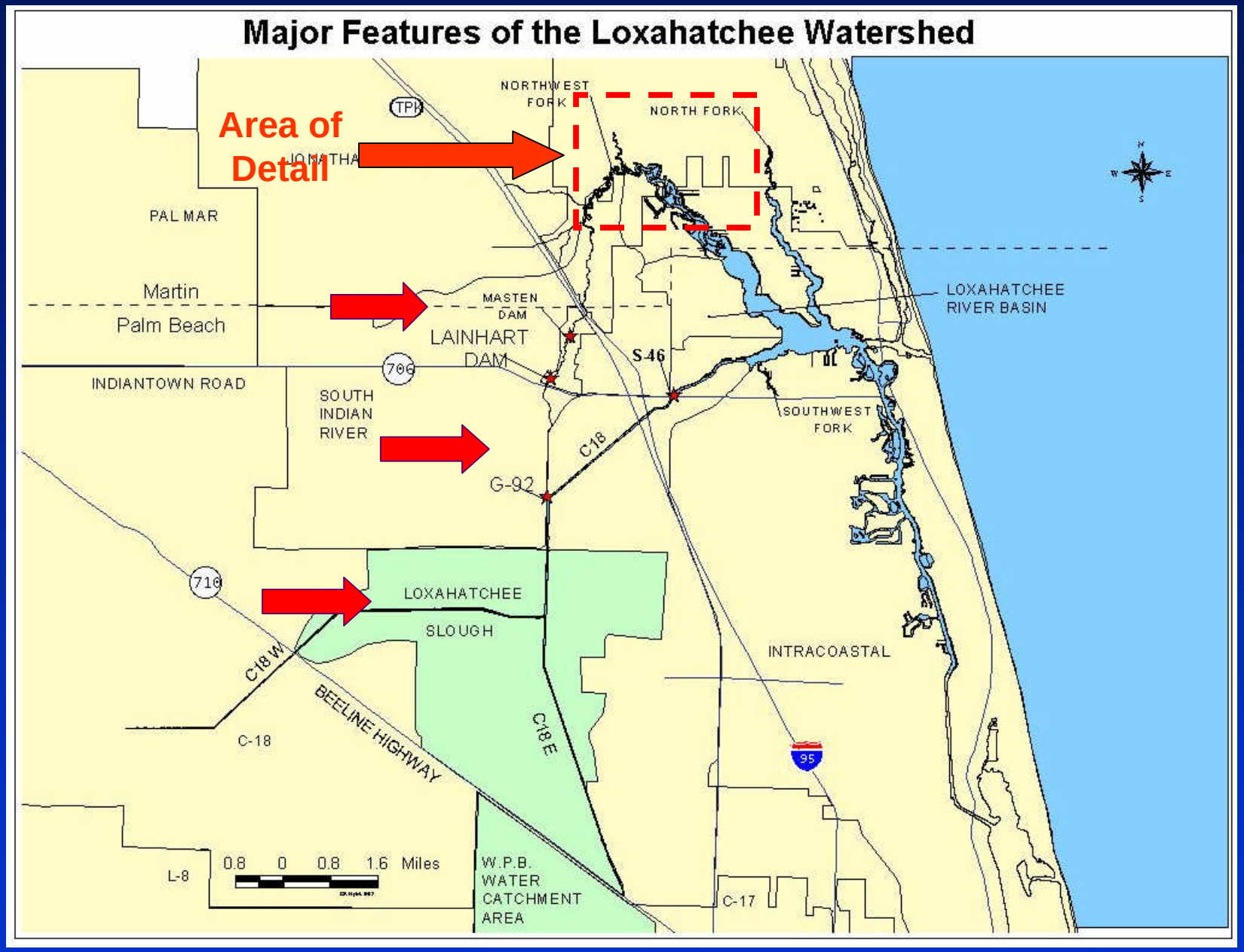
Definitions

Minimum Flow - means the limit at which further withdrawals would be significantly harmful to the water resources of the area (section 373.042(1) F.S)

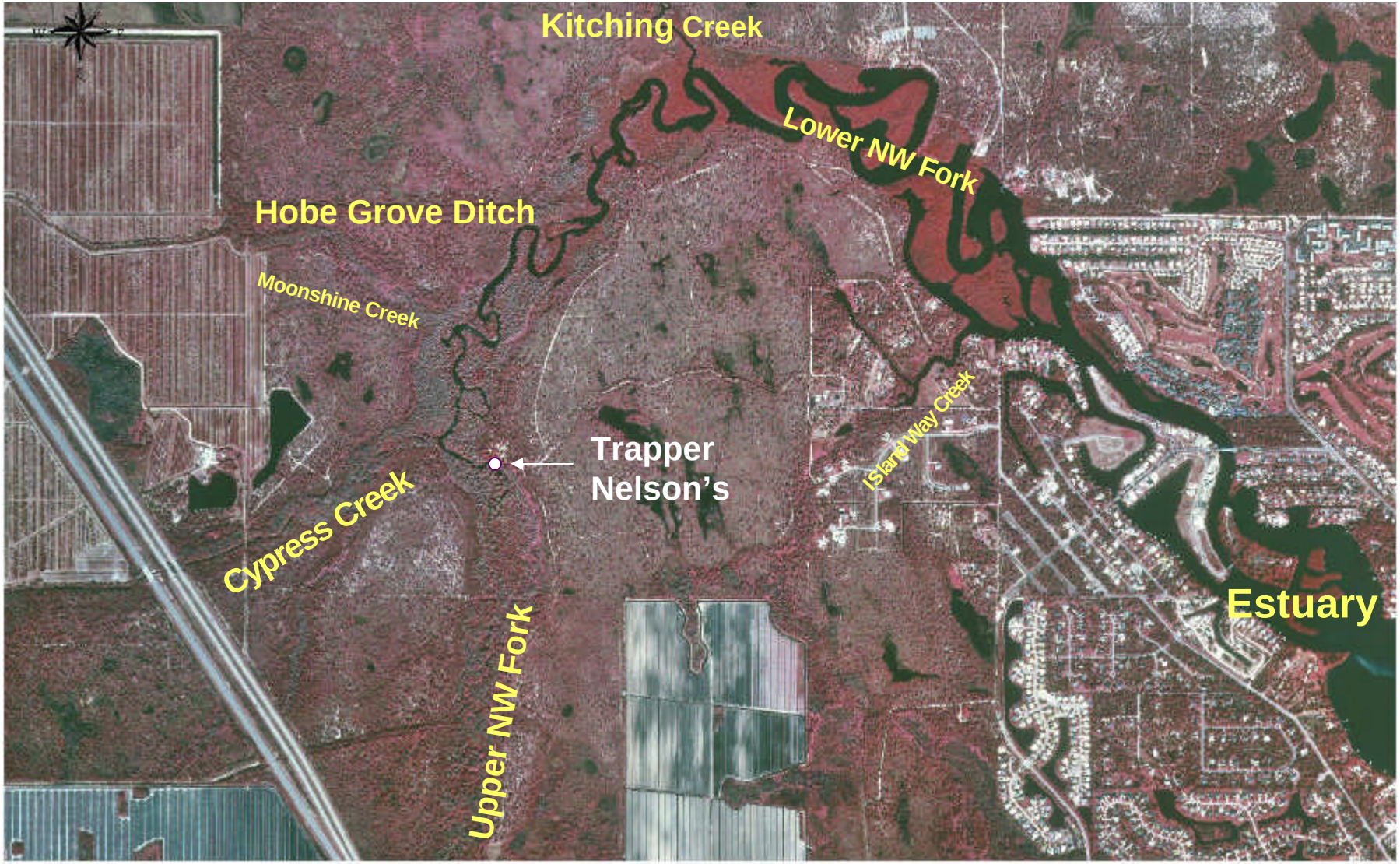
Significant Harm - means the temporary loss of water resource functions, which result from a change in surface or ground water hydrology, that takes more than two years to recover, but which is considered less severe than serious harm (CH. 40E-8.021(24), F.S.)

MFL Development Process

- **1st Draft** Technical Document released May 2001
  Peer Review completed July 2001
- Rule Development initiated June 2001
- Document revised based on Peer Review, FDEP & public comments
- **2nd Draft** released July 2002. Peer Review completed September 2002
- Document revised based on Peer Review, FDEP & public comments
- Release of **Final Draft** & proposed **Draft Rule**, November 2002


Major Features of the Loxahatchee Watershed
Area of Detail
NORTHWEST FORK
NORTH FORK
TPK
PAL MAR
Martin
Palm Beach
MASTEN DAM
LAINHART DAM
S-46
LOXAHATCHEE RIVER BASIN
INDIANTOWN ROAD
706
SOUTH INDIAN RIVER
SOUTHWEST FORK
C18
G-92
710
LOXAHATCHEE SLOUGH
INTRACOASTAL
C18 W
BEELINE HIGHWAY
C-18
C18 E
95
L-8
0.8 0 0.8 1.6 Miles
W.P.B. WATER CATCHMENT AREA
C-17

Major Tributaries of the NW Fork of the Loxahatchee River



History

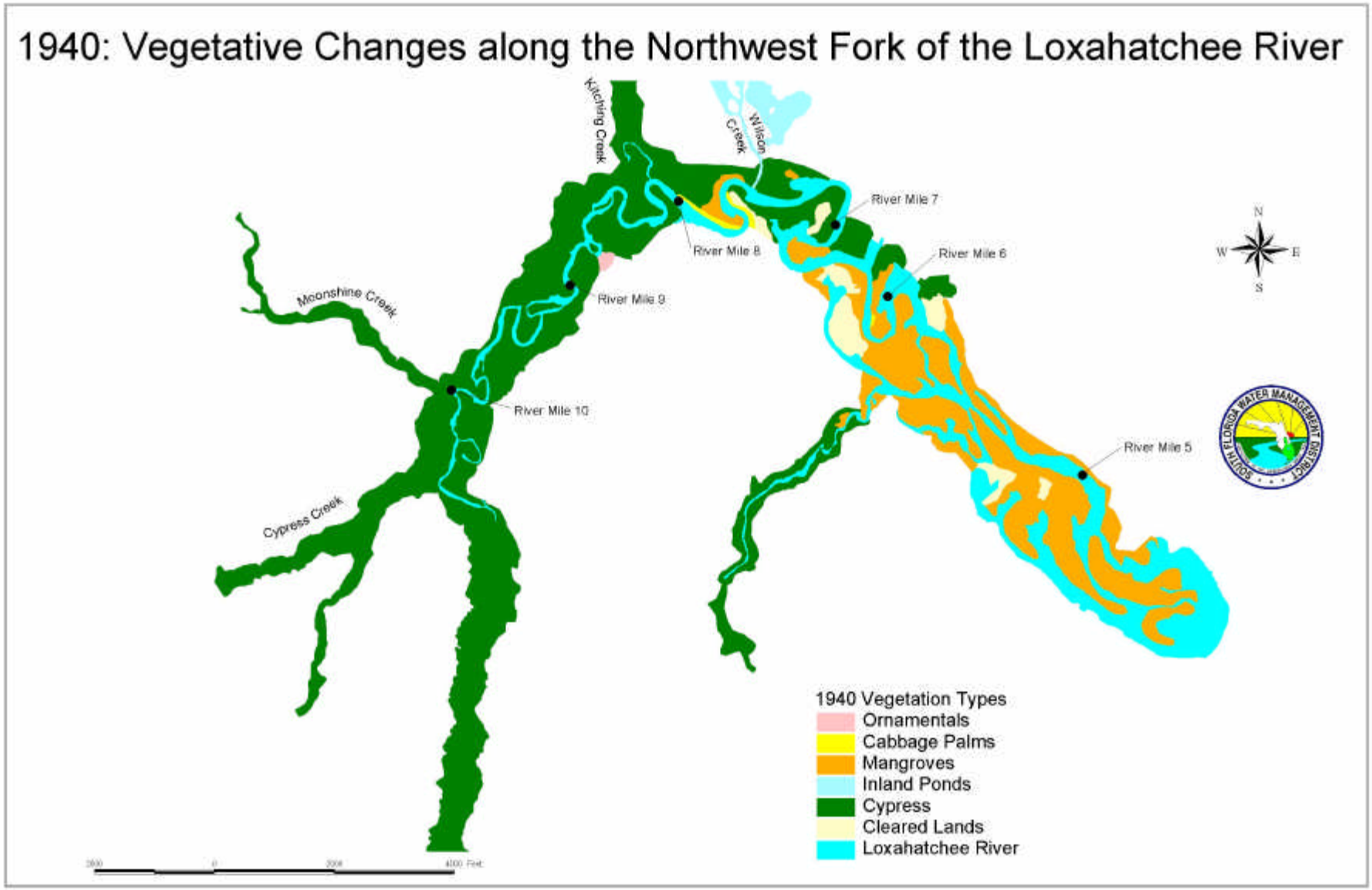
- Historically, the Loxahatchee Estuary opened and closed to the Atlantic ocean as a result of natural causes (major floods, hurricanes)

- The estuary and lower river system oscillated between a freshwater and brackish water system in response to periodic opening and closing of the inlet.

Hydrologic and Structural Changes

- Permanent opening of the Jupiter Inlet (1947)
- Construction of the C-18 Canal and S-46 structure (1957-1958)
- Dredging of the inlet, estuary and lower portion of the NW Fork for navigation purposes (since the 1930's)
- Major roads (Beeline Highway, Northlake Blvd, Florida Turnpike, Bridge Road) intersect wetland flow ways that historically fed the NW Fork

1940: Vegetative Changes along the Northwest Fork of the Loxahatchee River



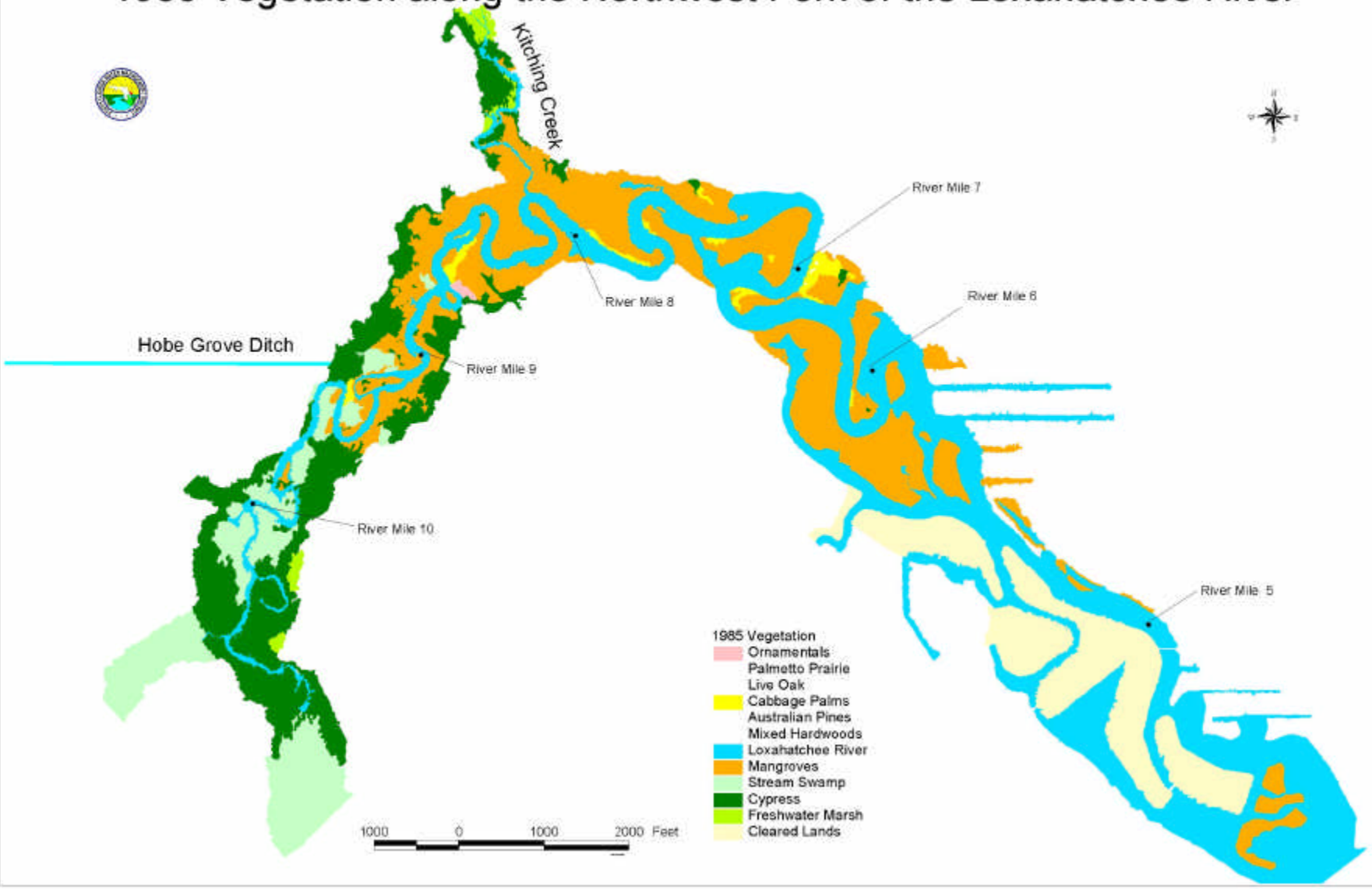
Environmental Change

- By the 1970s it was recognized that these hydrologic changes have resulted in the upstream movement of saltwater during the dry season (Rodis 1973, Alexander & Crook 1975)
- These changes have slowly resulted in the loss of the lower portion of NW Fork's floodplain swamp due to saltwater encroachment - - the primary problem affecting the river

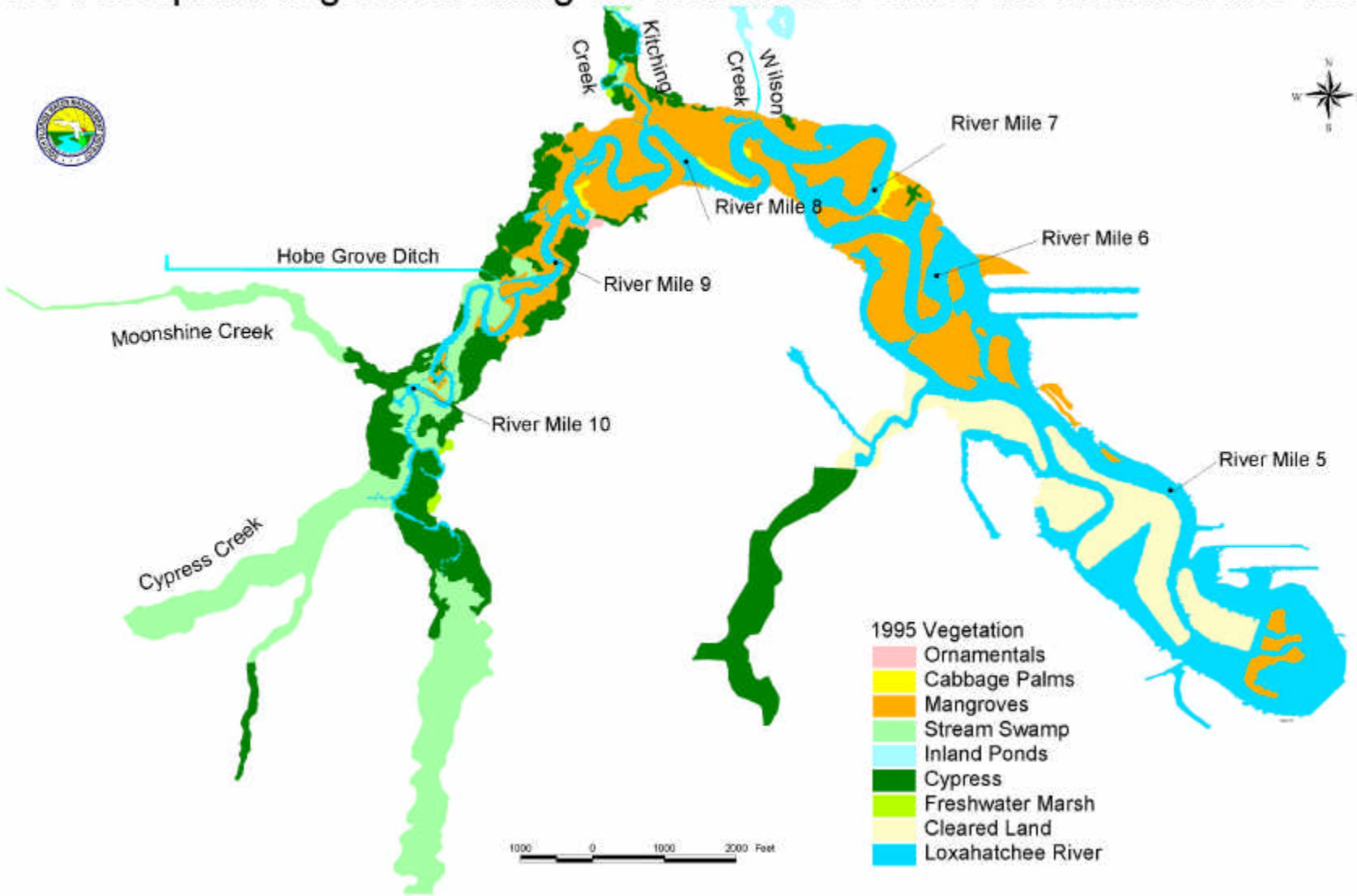
Upstream NW Fork - Unharmed, Healthy Floodplain Swamp

Downstream NW Fork- Mangroves, Cabbage Palm and dead Cypress snags

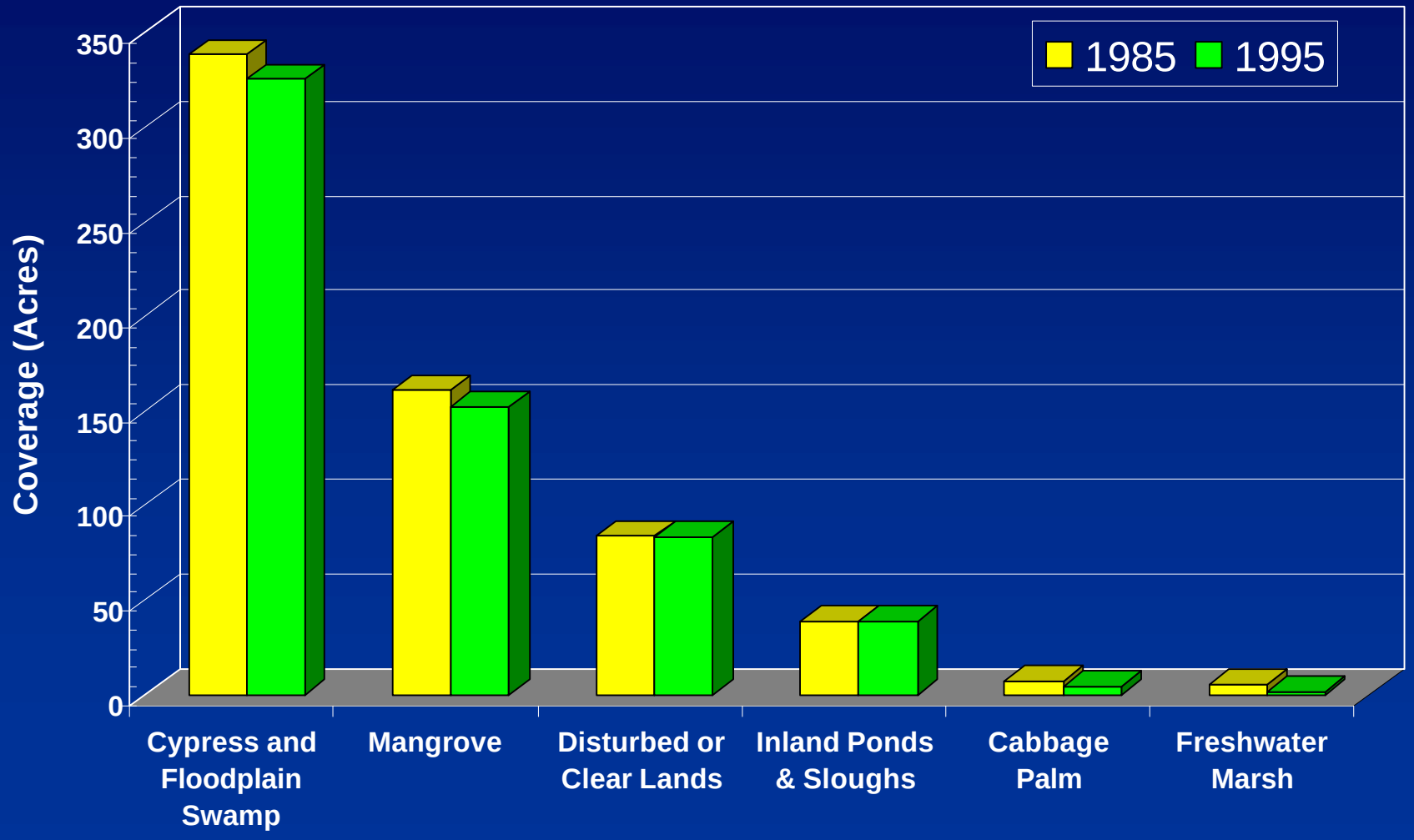
1985 Vegetation along the Northwest Fork of the Loxahatchee River



1995: Floodplain Vegetation along the Northwest Fork of the Loxahatchee River



1985 & 1995 River Vegetation Coverage
NW Fork, Loxahatchee River



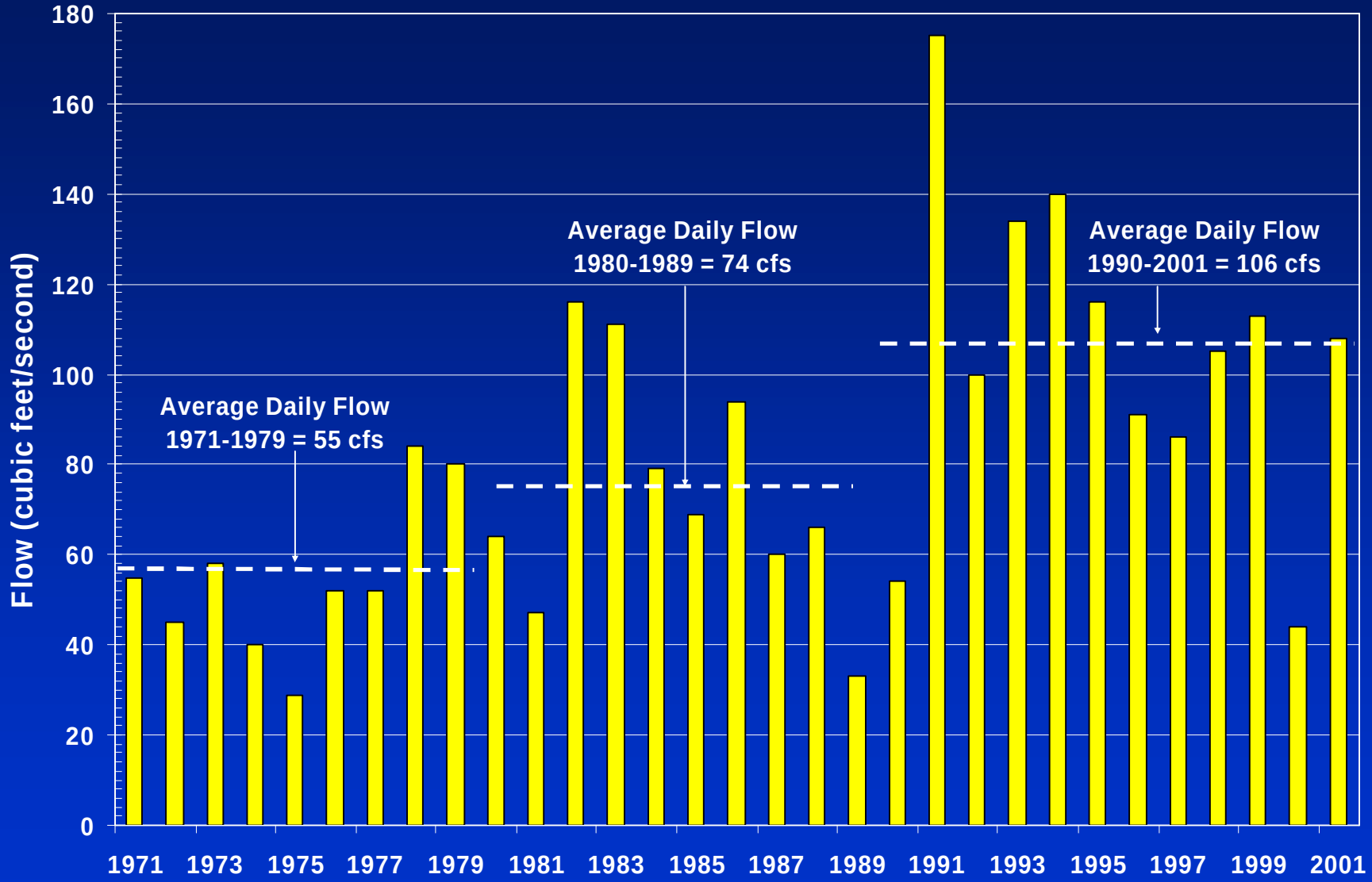
Hydrologic Improvements

- In 1974, the G-92 structure was constructed to re-divert water from the C-18 basin back to the Northwest Fork
- In 1982, agreements were made to provide a base flow of 50 cfs to the Northwest Fork subject to available water supply
- In 1985, the Loxahatchee River became the state's first federally designated "Wild and Scenic River"

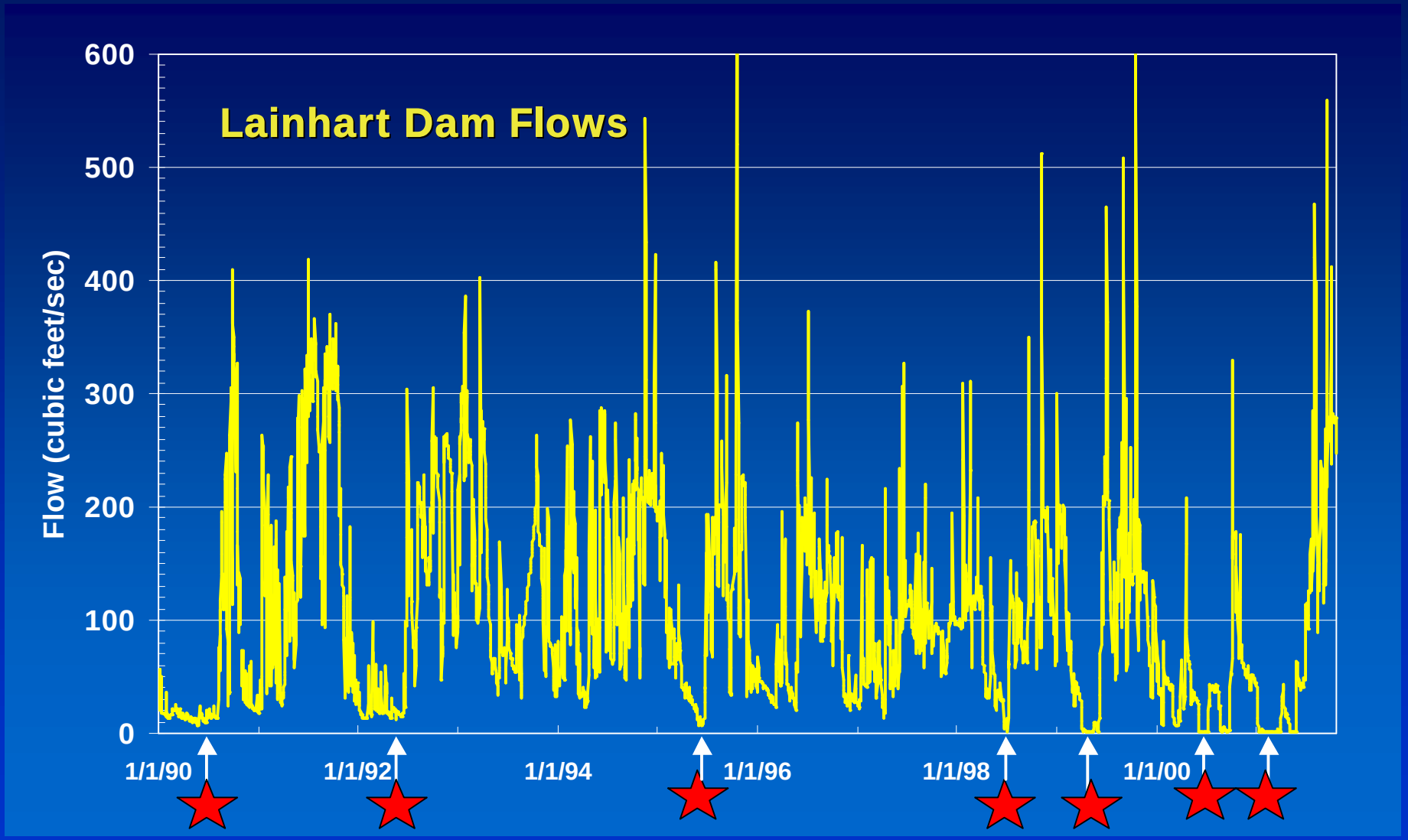
Hydrologic Improvements

- In 1987, the capacity of the G-92 structure was improved making it capable of passing up to 400 cfs to the NW Fork by remote telemetry
- These improvements, in combination with above normal rainfall, increased the volume of water delivered to the NW Fork over the last 12 years
- However, due the basin's limited water storage capacity, the river still experiences low flow periods 11 out of 12 years.

Lainhart Dam Average Daily Flows (1971-2001)



The Minimum Flow Problem



MFL Criteria Development Methods

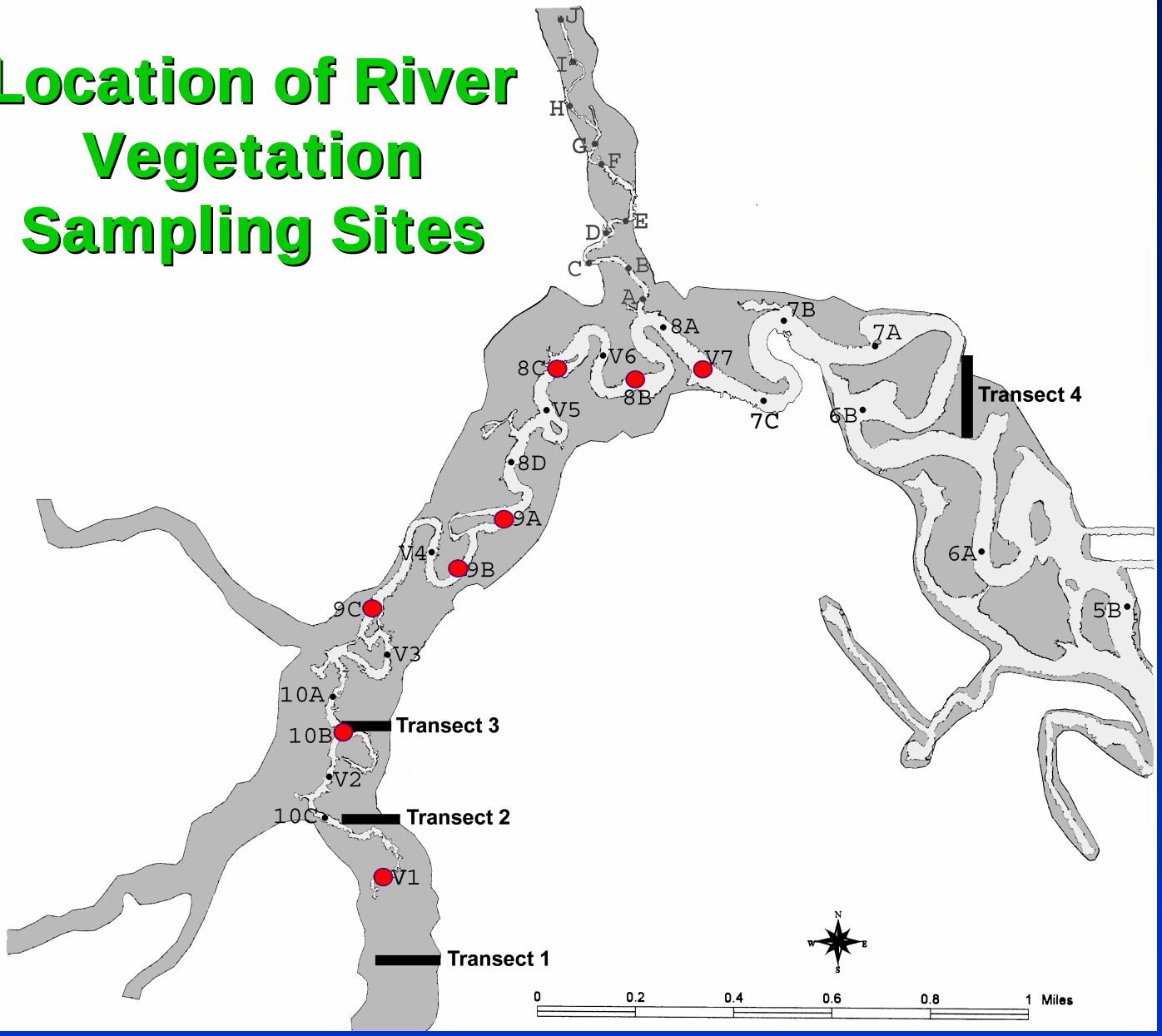
District staff conducting a river vegetation survey

SFWMD River Vegetation Survey

Determination of Indicator Species

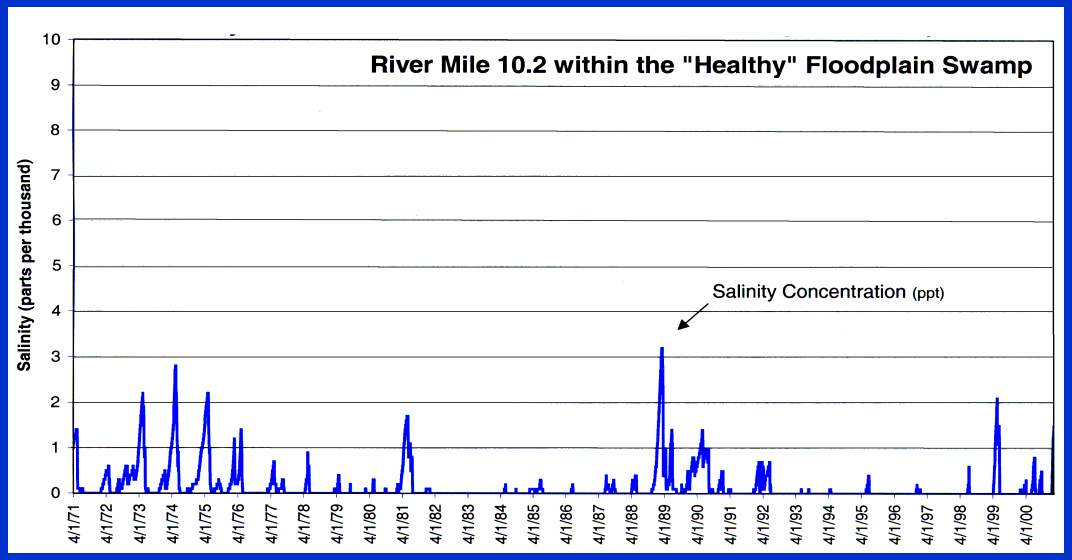
- Surveys were conducted to characterize river plant communities relative to the salinity gradient.
- Measured parameters included:
  - Percent canopy cover
  - Species abundance & total number of species
  - Tree height & trunk diameter
  - Presence of saplings or seedlings etc.
- These data were used to determine at what point in the river does “significant harm” occur

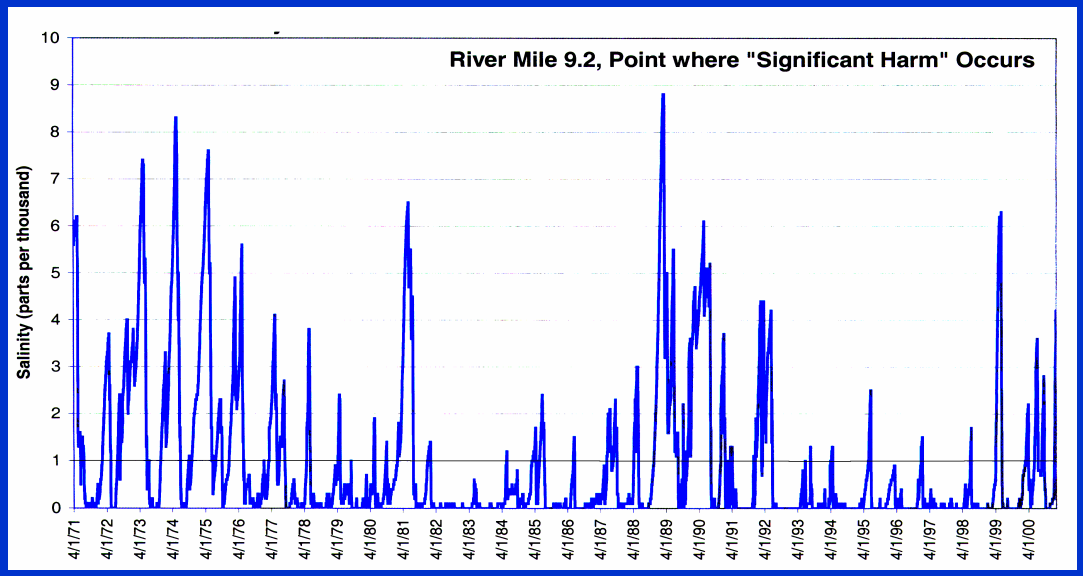
Location of River Vegetation Sampling Sites



Methods - Salinity Time Series

- Long-term (30 year) salinity records do not exist
- A **2-D hydrodynamic-salinity model** (USACE, 1996) was used to "hindcast" a salinity time series for 8 selected river vegetation sites
- Model output was analyzed in terms relevant to a plant community:
  - **Salinity Magnitude** and **Range** (ppt)
  - **Duration** of a salinity event (days)
  - **Return Frequency** of a salinity event (how often does an event occur)





Simulated Salinity Time Series for River Miles 10.2 and 9.2

Source: 2-D Hydrodynamic/Salinity Model

For Each Site:

1. **A QUANTITATIVE DESCRIPTION OF THE RIVER VEGETATION COMMUNITY** defined in terms of:
   - Species composition & abundance
   - % Canopy cover, tree height & diameter
   - Presence of seedlings or saplings

2. **A 30-YEAR TIME SERIES OF RIVER FLOW AND SALINITY** defined in terms of:
   - Salinity Magnitude, duration & return frequency

River Vegetation Survey Results

Key Freshwater Indicator Species

Species	Saltwater Tolerance
Selected Indicator Species	
Red maple *(Acer rubrum)*	Freshwater[a]
Pop ash (*Fraxinus caroliniana*)	Freshwater[a]
Virginia willow (*Itea virginica*)	Freshwater[a]
Dahoon holly (*Ilex cassine*)	Freshwater[a]
Red Bay (*Persea borbonia*)	Freshwater[a]
Pond apple (*Annona glabra*)	Freshwater[a]
Other Dominant River Vegetation Species	
Bald cypress (*Taxodium distichum*)	Freshwater to slight salt tolerance[c]
Cabbage palm (*Sabal palmetto*)	Freshwater to slight salt tolerance[b]
Red mangrove (*Rhizophora mangle*)	Salt tolerant[a]

[a] see Tobe, et al. 1998.
[b] Cabbage palm is generally associated with freshwater and coastal swamps
[c] see Allen 1994; Allen et al. 1994, 1997; Conner 1992; Javanshir & Ewel 1993, Pezeshki et al. 1986, 1987, 1990, 1995

River Vegetation Survey Results

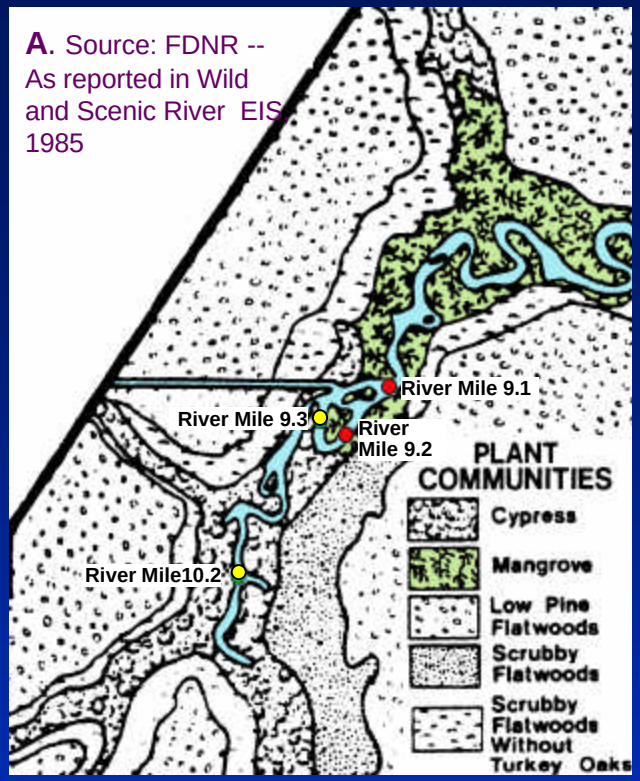
Measured Vegetation Parameter	Upstream → River Miles along Northwest Fork → Downstream							
	10.6	10.2	9.7	9.2	9.1	8.7	8.4	7.9
Presence/Absence of Key Species								
Percent Canopy Cover								
Presence of Seedlings & Saplings								
Number of Individuals								
Tree Height/Trunk Diameter								

Healthy Floodplain Swamp

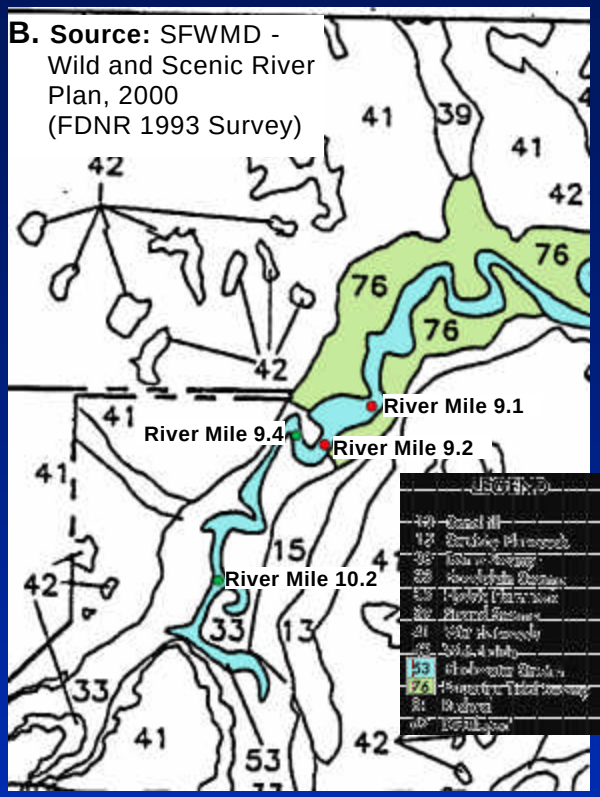
Observed Reduction in Parameter ("Stressed")

Loss of Freshwater Species or Functions (conversion to saltwater-tolerant mangroves)

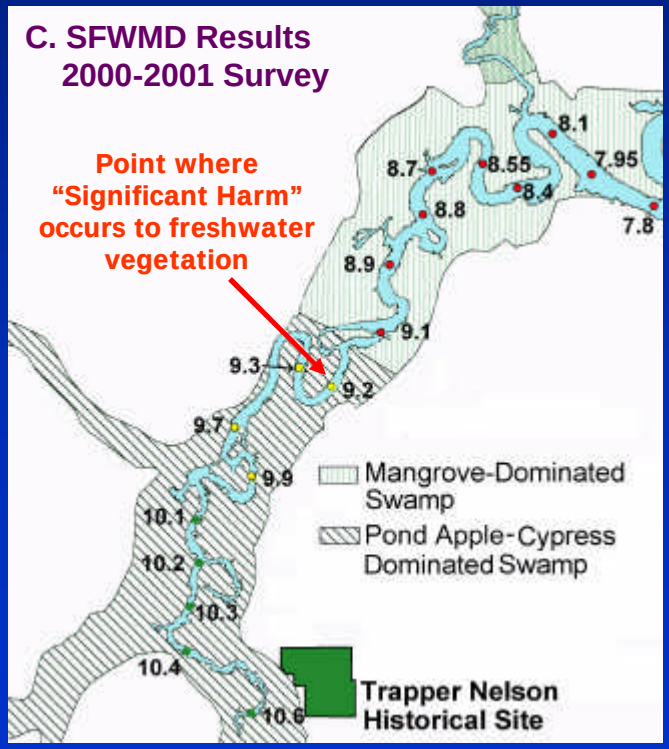
A. Source: FDNR -- As reported in Wild and Scenic River EIS, 1985



B. Source: SFWMD - Wild and Scenic River Plan, 2000 (FDNR 1993 Survey)



C. SFWMD Results 2000-2001 Survey

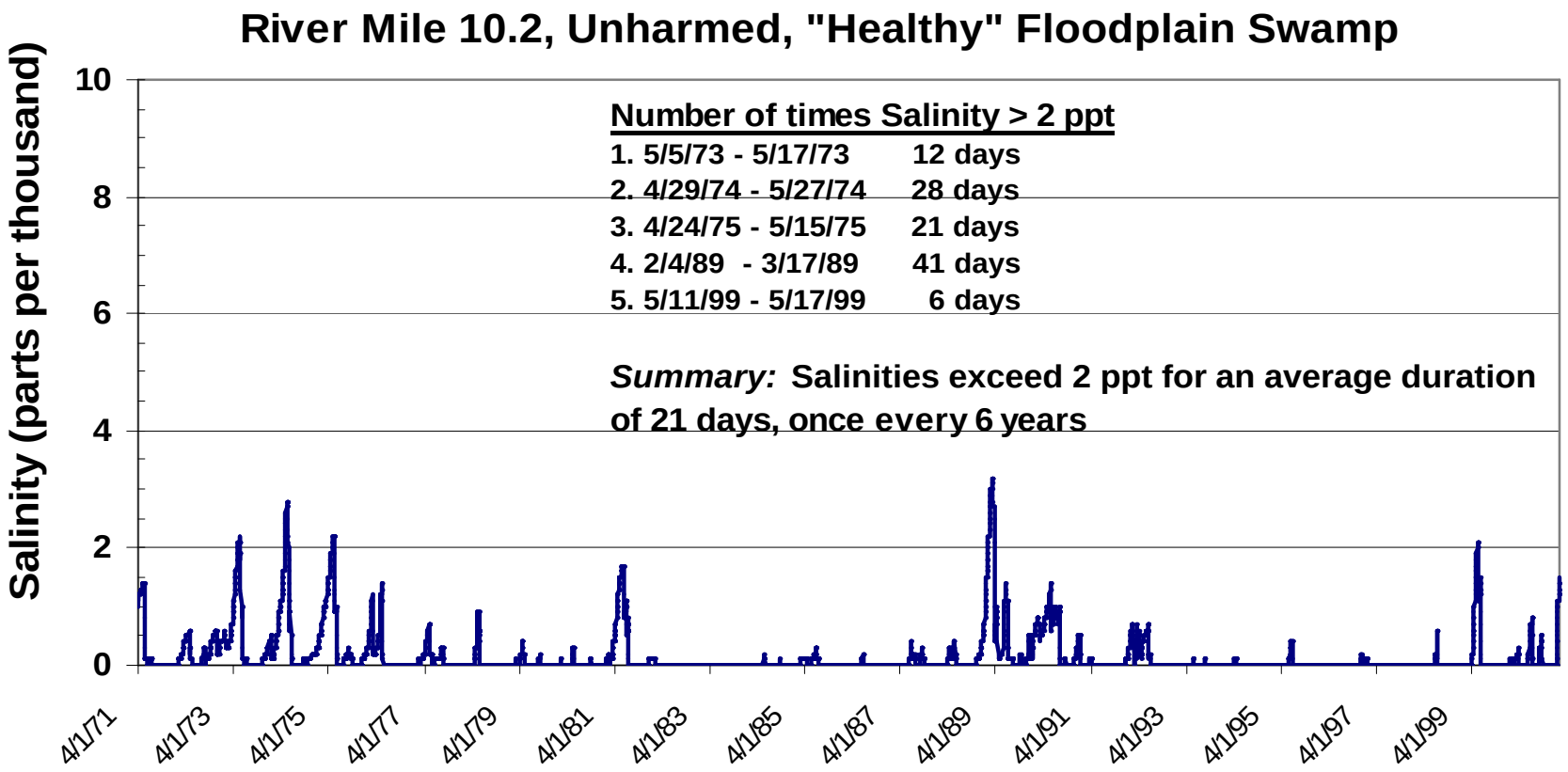


Resource Protection Criteria

- Provide a flow regime that will mimic salinity conditions that currently exist at river mile 10.2 (the “healthy” Floodplain swamp) and transfer this flow regime downstream to river mile 9.2 to prevent significant harm

- Model results show that at RM 10.2, salinity should not exceed 2 ppt, for more than 20 days duration, more often than once every 6 years to maintain this community.

Hydrodynamic/Salinity Model Results



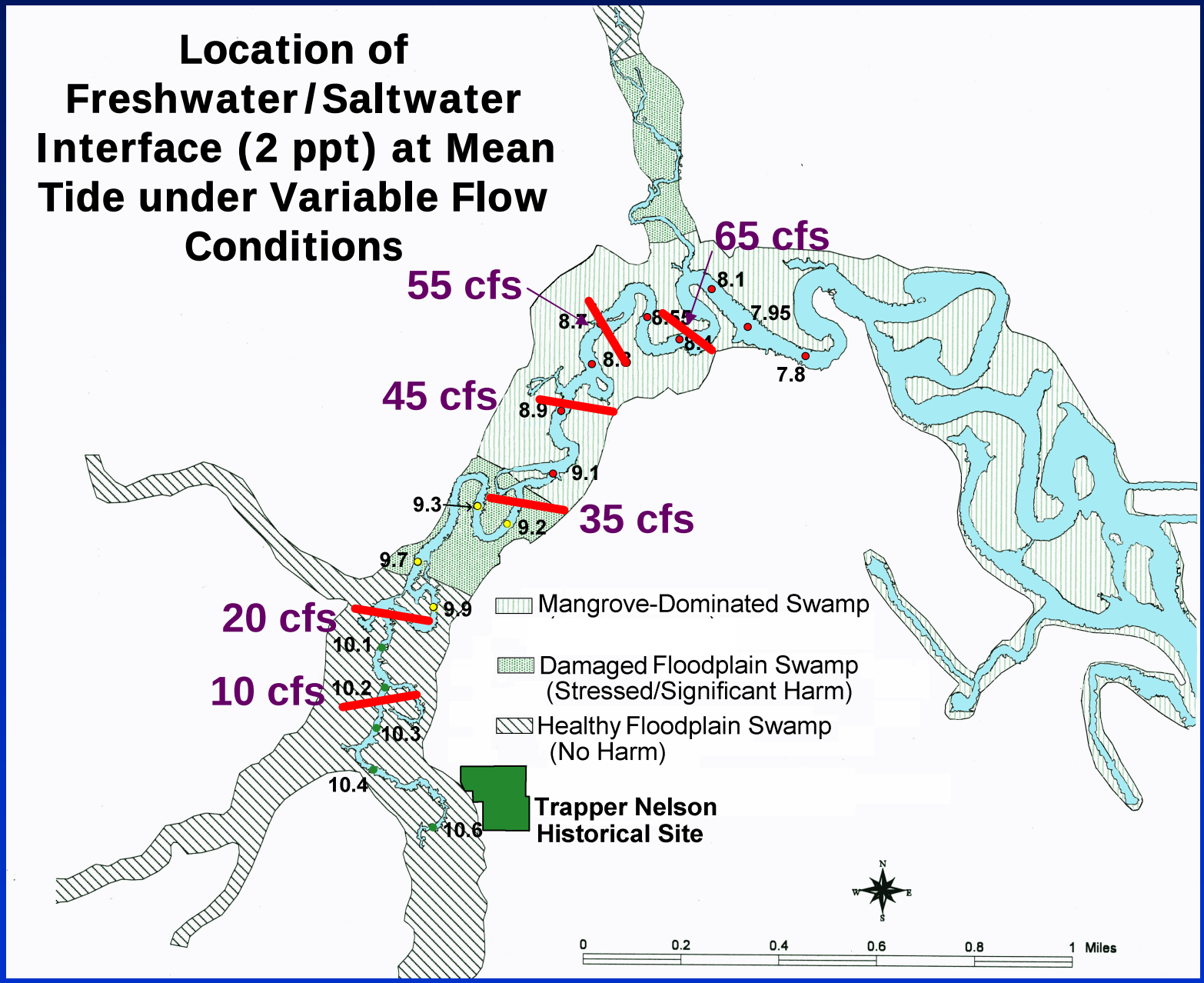
Model results show that Lainhart Dam flows within the 35 cfs range are required to maintain average salinity levels at 2 ppt at river mile 9.2

Flow (cfs)	Mean Tide Salinity levels (ppt) [b]							
	RM 10.2	RM 9.7	RM 9.4	RM 9.2	RM 8.9	RM 8.6	RM 8.35	RM 7.7
65	0.1 [a]	0.2	0.2	0.3	0.7	1.3	1.9	4.2
55	0.1	0.3	0.4	0.6	1.1	2.0	2.8	5.5
50	0.1	0.3	0.5	0.8	1.3	2.3	3.3	6.2
45	0.2	0.4	0.7	1.1	1.8	2.9	4.0	7.1
40	0.2	0.6	0.9	1.4	2.2	3.5	4.7	8.0
35	0.3	0.9	1.3	1.9	2.9	4.4	5.7	9.2
30	0.4	1.1	1.8	2.5	3.6	5.3	6.7	10.4
20	0.8	2.3	3.3	4.2	5.6	7.7	9.3	13.1
10	2.0	4.7	5.9	7.2	8.8	11.2	12.8	16.6

[a] Values represent mean tide salinity levels averaged for the entire water column

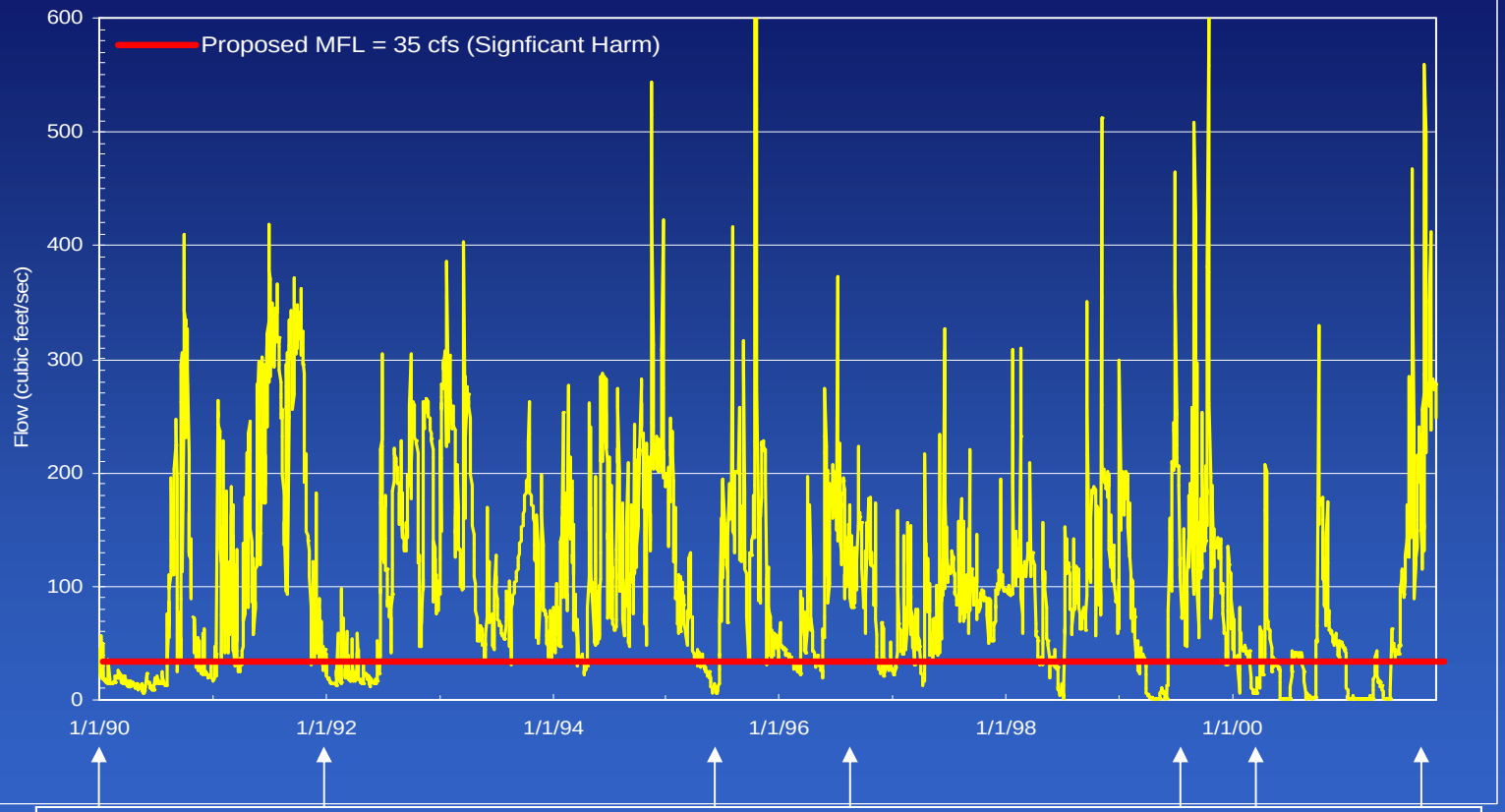
[b] Source: Models results from Loxahatchee River/estuary Hydrodynamic/salinity model

Location of Freshwater/Saltwater Interface (2 ppt) at Mean Tide under Variable Flow Conditions



Bottom Line: For the last 12 years, the 35 cfs flow target has been exceeded about once every 2 months for 15 days (on average)

Lainhart Dam Flows (1990-2001)



Number of Days/year Lainhart Dam Flows were less than 35 cfs											
1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
264	32	153	6	20	60	88	33	48	84	151	142

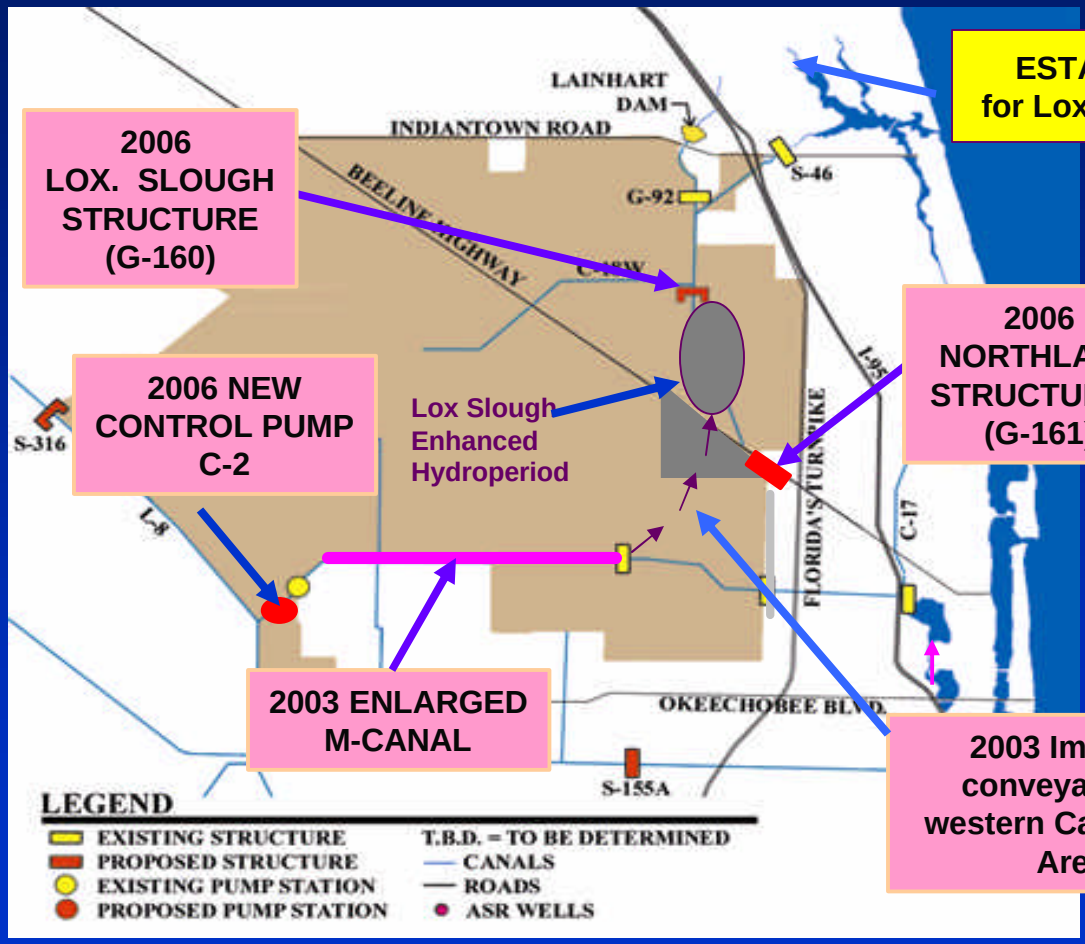
Total 1,081

Proposed MFL Criteria

It is the goal of the District to provide sufficient freshwater flows to create at River Mile 9.2 the salinity regime found at River Mile 10.2

A MFL violation occurs within the NW Fork of the Loxahatchee River when an exceedance occurs more than once every six years. An "exceedance" is defined as when Lainhart Dam flows decline below 35 cfs* for more than 20 consecutive days within any given calendar year.

Loxahatchee MFL Recovery Plan
Phases 1- 2 (by 2006)



MFL Recovery Plan (con't)

Phase 3 (2011-2014)

- Water Catchment Area perimeter canal improvements
- Capture J.W. Corbett WMA runoff for storage within Loxahatchee Slough
- Construction of **L-8 reservoir** - 48,000 ac-ft of storage capacity

Phase 4 (2018)

- Construction of 10, 5 MGD **ASR wells** (50 MGD injection capacity) to increase basin storage

Percent of Time Loxahatchee River Flow Targets are Met: Current & Future Conditions

Flow Target	1995 Base Case (without improvements)	2006 (with G-160 + G-161)	2018 (with all NPCCWMP projects on line)
65 cfs	41%	70%	99.2%
50 cfs	46%	81%	99.4%
35 cfs	51%	94%	100%
20 cfs	56%	99%	100%
10 cfs	80%	99.1%	100%
5 cfs	94%	100%	100%

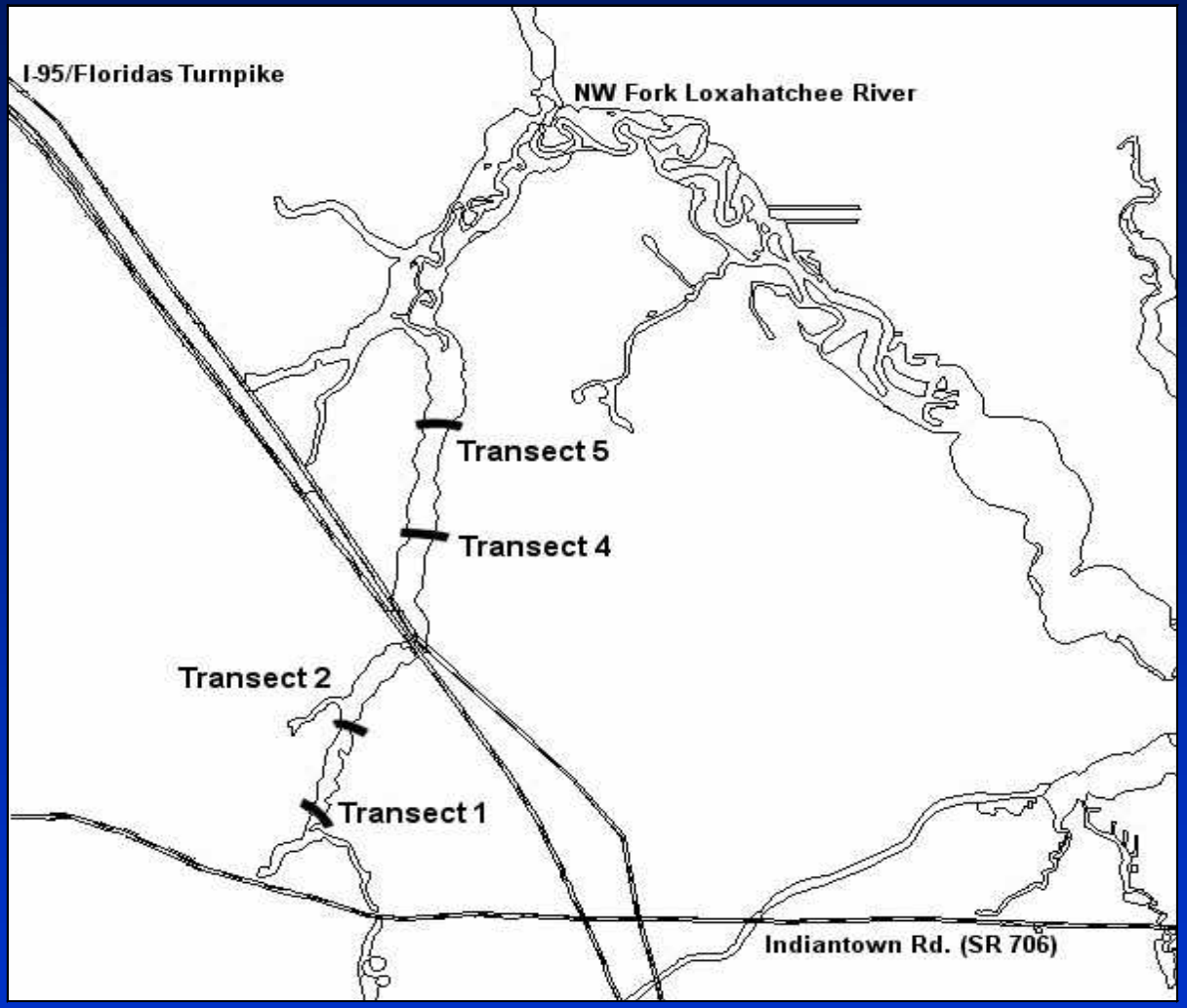
Source: Model results from the Northern Palm Beach County Comprehensive Water Management Plan

Estuarine Impacts

- Central Embayment Area – No adverse effects
- North Fork & SW Fork – No adverse effects
- Lower Portion of NW Fork – May provide more stable oligohaline (1-5 ppt) habitat & improve dry season estuarine conditions that support oyster and seagrass communities

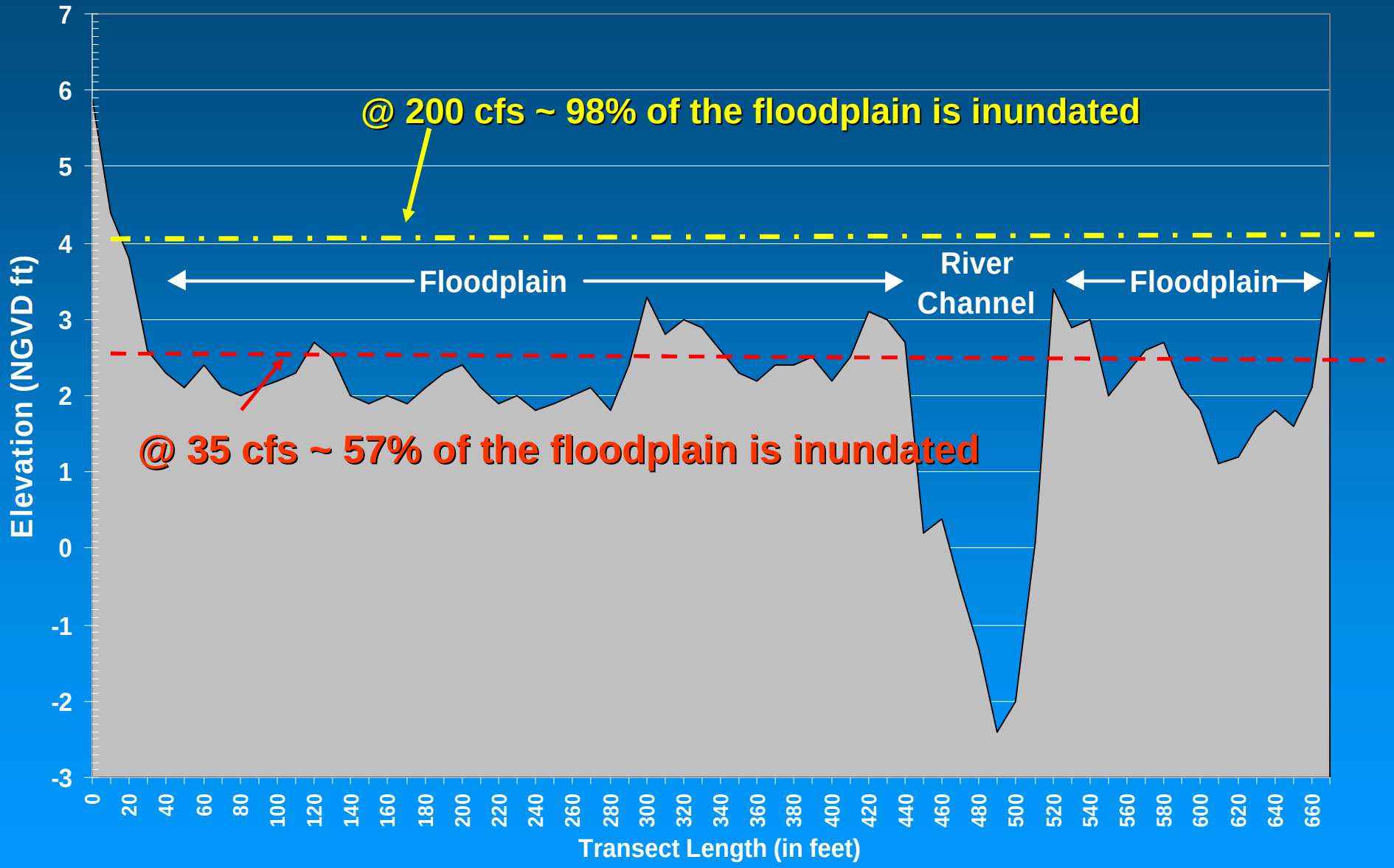
Basis: Review of Russell & McPherson (1984) data; 2-D hydrodynamic model output

Floodplain Swamp Water level Impacts

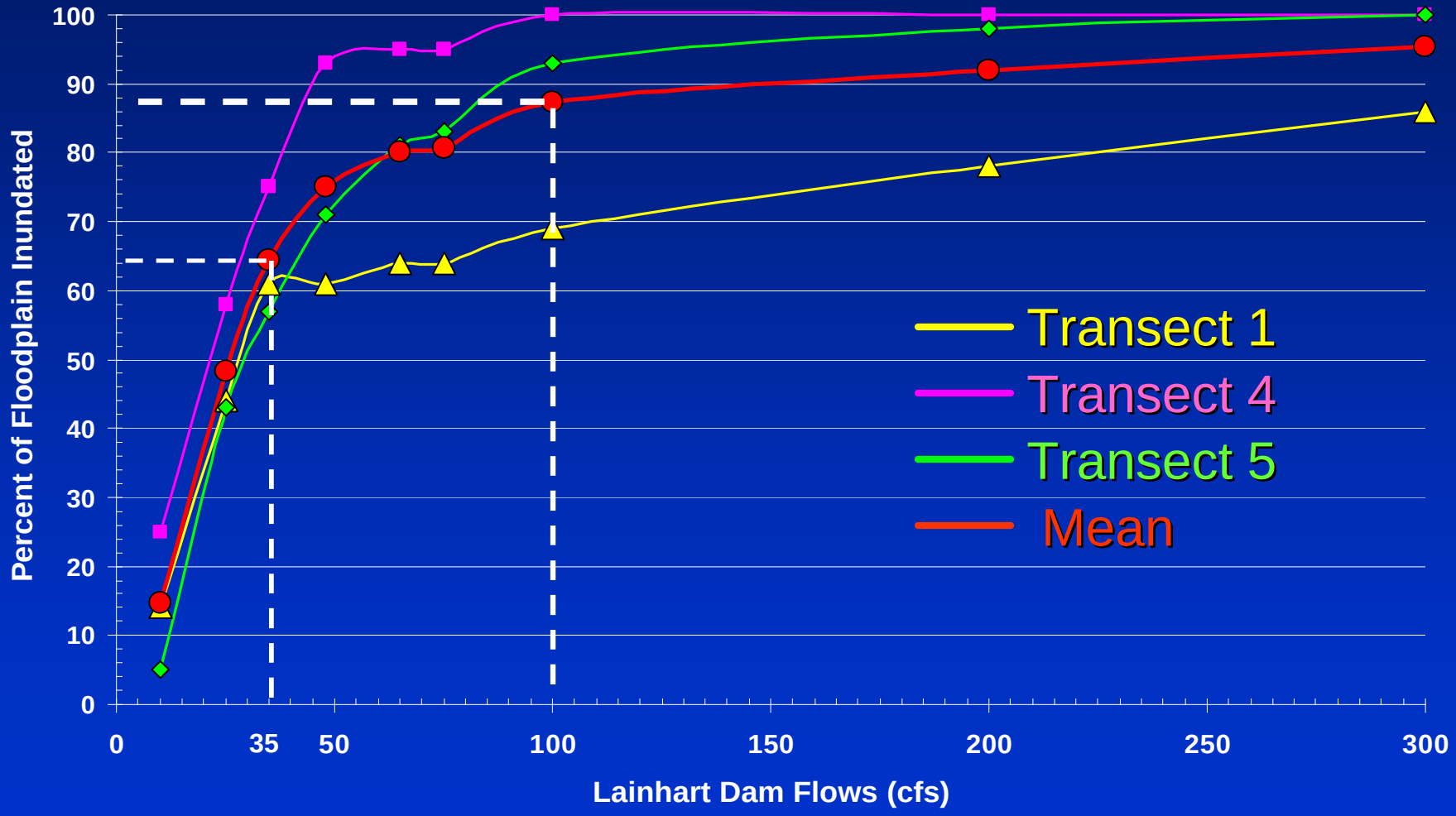


Location of Floodplain Transect Surveys (1984-1990)

Transect 5, Northwest Fork of the Loxahatchee River



Lainhart Dam Flows vs. Percent of Floodplain Inundated



Additional SFWMD Commitments

River Restoration Initiative:

- SFWMD and FDEP have partnered to develop a practical **Restoration Goal** for the Loxahatchee River & Estuary.
- The SFWMD will also implement river restoration projects as contained in LEC Plan, NPBCCWMP and CERP
- As new information becomes available, **the MFL will be reviewed and revised consistent with the Restoration plan**

SFWMD Commitments (Con't)

Proposed Research:

- Three year program to evaluate and refine the proposed MFL Criteria
- Develop a Natural System Model (NSM) for the Loxahatchee Watershed
- Upgrade the Hydrodynamic Model to a 3-D version
- Develop a Loxahatchee River Watershed model
- Conduct a Salinity Barrier Feasibility Study

SFWMD Commitments (Con't)

Monitoring Studies

- USGS monitoring of Cypress Creek, Hobe Grove Ditch and Kitching Creek is underway
- Salinity & flow monitoring at key locations
- Floodplain groundwater & soil salinity monitoring
- River corridor vegetation monitoring

SFWMD Commitments (Con't)

Water Reservations

- Adopt an initial water reservation for the Northwest Fork of the river by 2004
- As reservations are adopted to restore the NW Fork beyond the MFL, the District will revise the minimum flow to be consistent with the reservation
- Water Reservations will be adopted for the River on a project by project basis over the next 20 years pursuant to CERP requirements

SFWMD Commitments (Con't)

- Continue to operate the G-92 structure to provide 50 cfs of flow over Lainhart Dam when water is available
- Initiate **Environmental Resource Permit (ERP) rulemaking** to establish supplemental criteria for projects located within the Loxahatchee watershed
- Review **Consumptive Use Permit (CUP) applications** based on the "Basis of Review" consistent with the approved MFL Recovery Plan

MFL Rule Development Schedule

Nov. 14	GB Meeting - MFL Update & Rule Development Schedule
Nov. 15	Mail out Final Draft Technical Document, post Draft Rule on Internet
Nov. 18	Loxahatchee River Coordinating Council
Nov. 19	**Rule Development Workshop** (Clayton Hutchinson Bld., 2- 4 p.m., WPB)
Nov. 21	**Rule Development Workshop** (Jupiter Town Hall, 5:30-7:30pm)
Dec. 9	**Rule Development Workshop** (Clayton Hutchinson Bld., 9:30 am- 4:30 p.m., WPB)
Dec. 12	GB meeting to approve Technical Criteria, authorize publication of Final Rule in F.A.W.
Feb. 13	GB Public Hearing to adopt Rule